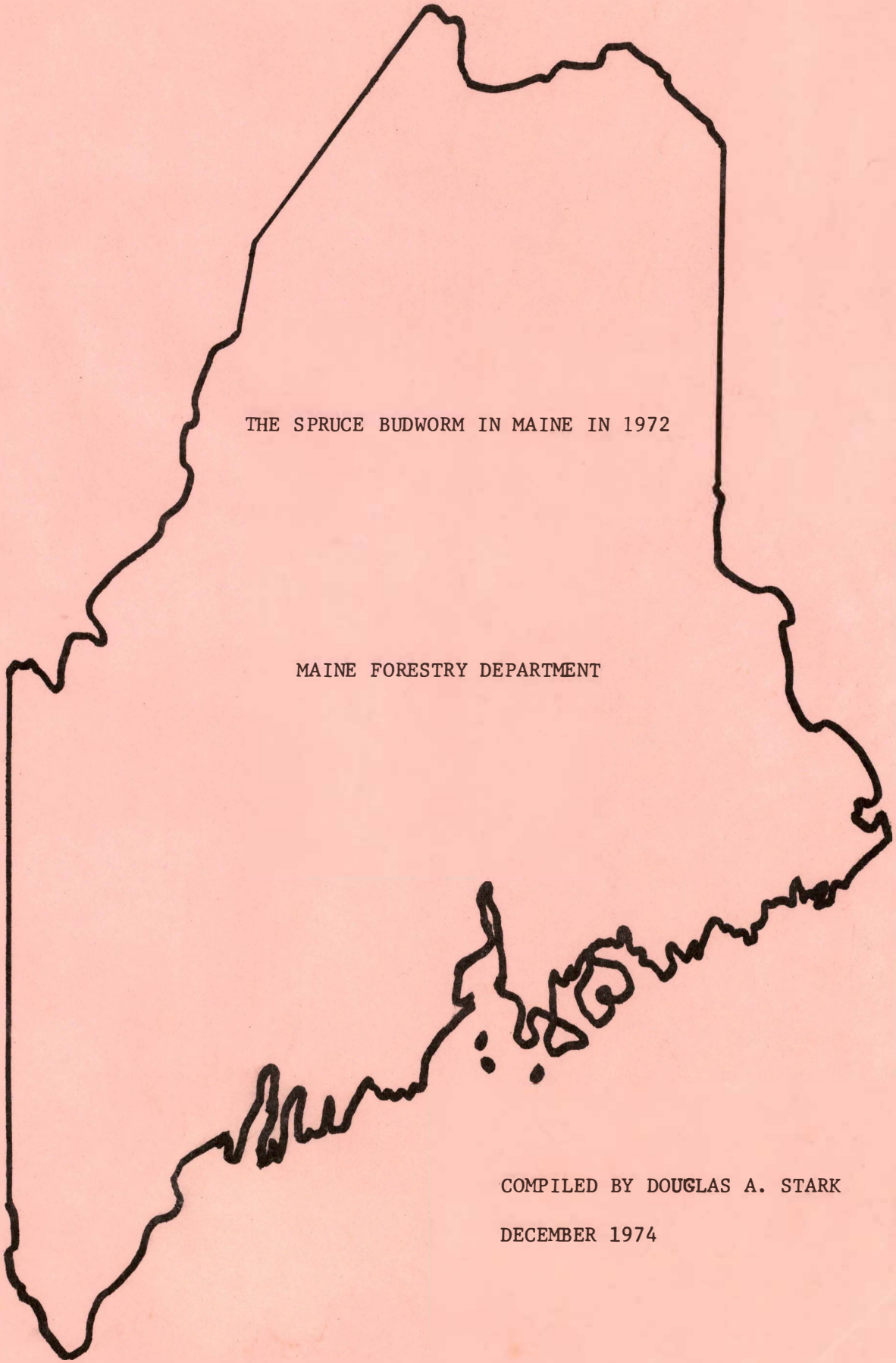
Richard I Washburn



THE SPRUCE BUDWORM IN MAINE IN 1972

MAINE FORESTRY DEPARTMENT

COMPILED BY DOUGLAS A. STARK

DECEMBER 1974

PREFACE

The preparation and release of this, the 1972 Spruce Budworm Report was delayed for two years due to a change in personnel assignments and associated unsettled conditions at the time the report normally was compiled. The report is past history and has been preceeded by the 1973 report; however, for the sake of retaining continuity of the reports and as a historical record for the project of that year, it is desirable to release the report at this time. The contribution to this report by the entomology staff at the time is hereby acknowledged.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
LARVAL DEVELOPMENT AND PRE-SPRAY SURVEYS	3
1972 SPRAY OPERATION AND RESEARCH	3
Contact Work	3
The Spray Operation	3
Post-Spray Larval-Pupal Survey	7
Spray Efficacy	7
Safety Precautions	7
Monitoring Studies	9
Research	9
FOREST INSECT SURVEY AND PARASITE COLLECTIONS	10
Forest Insect Survey Collections	10
Early and Late Larval-Pupal Parasitism	10
SPRUCE BUDWORM AT LIGHT TRAPS IN 1972	10
AERIAL DEFOLIATION SURVEY	10
EGG MASS SURVEY	16
AERIAL DAMAGE SURVEY	17
SUMMARY	17
CONDITIONS IN ADJACENT CANADIAN MARITIME PROVINCES	18

INTRODUCTION

The 1972 budworm-infested area in Maine was substantially larger than that of 1971 not only around the Cross Lake-Madawaska Lake and Squapan Lake-Oxbow spray areas, but also around the epicenters reported in 1971 in the Big 20-Beau Lake area, northeast of Moosehead Lake, west and north of Mt. Katahdin, and along the St. Croix River in Washington County. The same pattern of an enlarging epidemic and a substantial increase in infested acreage appears to be taking place in Quebec and New Brunswick also.

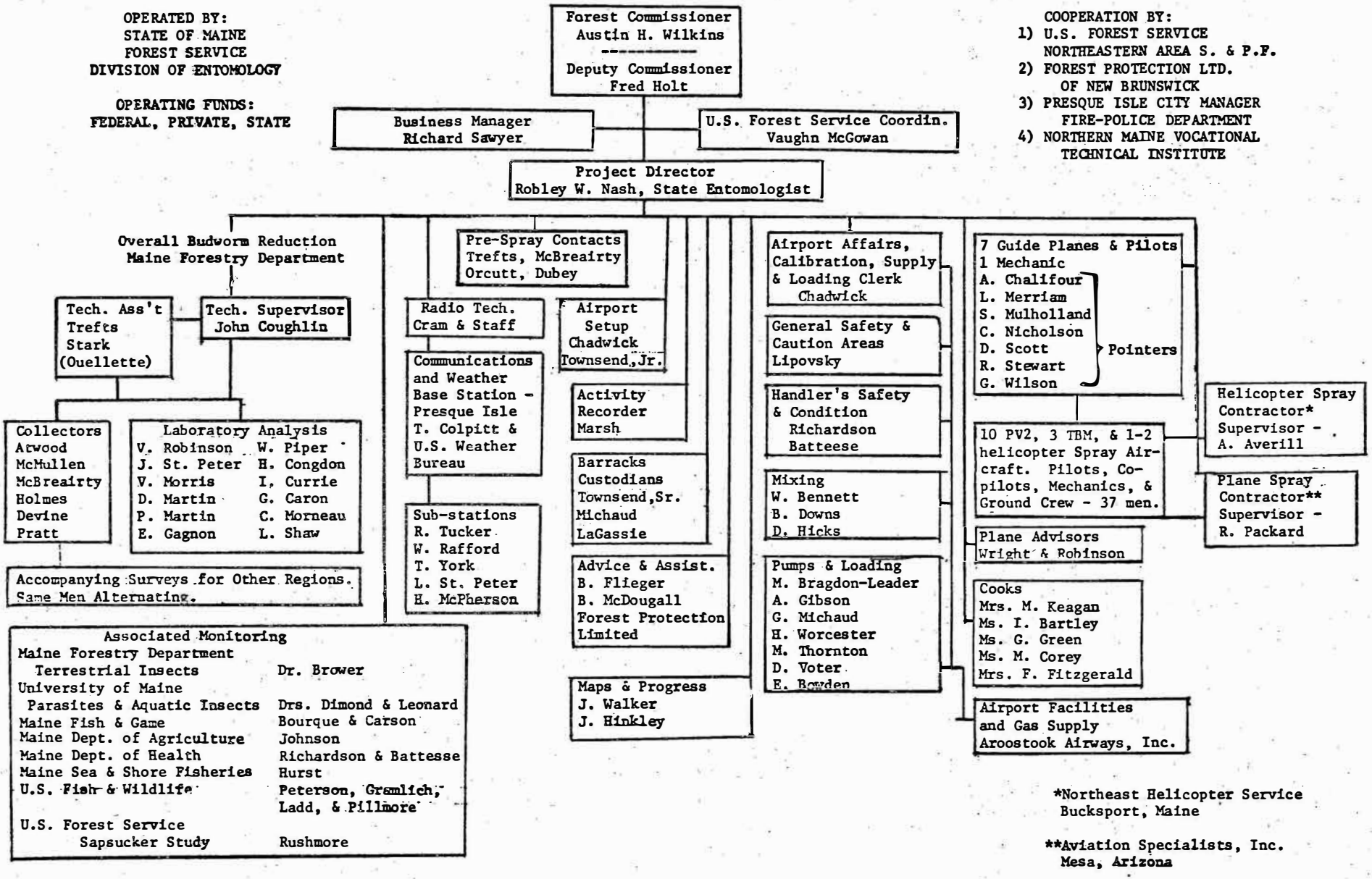
Meetings of the staff of the Division of Entomology and concerned industry representatives in the fall of 1971 resulted in the decision to treat 500,000 acres in the Cross-Madawaska Lake and Squapan-Oxbow areas of Aroostook County in 1972.

The problem persists in getting additional, effective, safe, economical insecticides registered for use against the budworm. At the present time our only insecticidal alternatives are malathion and Zectran, although fenitrothion was pilot-tested in 1970 essentially for possible registration.

Ground and aerial surveys and airport procedures were conducted as reported in preceeding reports by many of the same personnel, (Fig. 1), but with a change from a centralized to a regionalized system of administration.

FIGURE 1

JUNE, 1972, AROOSTOOK COUNTY, MAINE, SPRUCE BUDWORM PROJECT, 500,000 ACRES, AND ACCOMPANYING SURVEYS
BASE-Presque Isle Municipal Airport



LARVAL DEVELOPMENT AND PRE-SPRAY SURVEYS

A check of early larval development of the week of May 8, 1972 revealed that larvae had emerged from hibernaculae but had not yet entered the needle-mining stage in the Oxbow area. Regular development collections taken in the Portage area were started on May 24 (Fig. 2). Intensive pre-spray larval surveys were conducted the last week of May and the first week of June. Regular pre-spray collections were taken within and outside the spray area as in past years.

Medium budworm populations were noted as early as 1969 in the St. Croix area of Washington County and in 1972 larval populations there were as high as 30 per 15-inch twig.

1972 SPRAY OPERATION AND RESEARCH

Contact Work

At a January 5, 1972 staff meeting, plans were made for house-to house contact of all landowners in or close to the areas proposed for treatment. Instructions and contact literature were given to contact personnel on February 7 at Island Falls. Vacant camps were posted with a weather resistant card briefly describing the proposed project. Public Lot Lease Owners, Town Managers or Chairmen of the Board of Selectmen and year-round residents not found at home were mailed public notices and informational sheets of the proposed spray project.

In order that local people be well informed on the spray project, local news media were also contacted. John Logan of the Presque Isle T.V. station filmed the contact work and this was carried on the local station for public information purposes. Leonard Hutchins also wrote a budworm informational article on April 10 for his daily column in the local paper. In addition, a budworm brochure with color illustrations was issued as Circular No. 11, Jan. 1972.

Caution areas such as chicken houses, fish ponds and water supplies were flagged so that such areas could be avoided during actual spraying operations. Most of the contact work was undertaken by personnel of the Entomology, Management and Fire Control Divisions during March, April and May. Approximately 500 individual landowners were contacted during this period. Accurate records were maintained of all people contacted with names, addresses and descriptions of caution areas. Several public meetings were held, the first of which was at the Stockholm Legion Hall in September of 1971 when major local concern was expressed for the need for spruce-fir protection from further budworm damage.

The Spray Operation

The two spray areas in the 1972 spray project totalled approximately 500,000 acres, 350,000 of which were in the Oxbow area and 150,000 in the Cross-Madawaska Lakes area (Fig. 3).

FIGURE 2

DEVELOPMENT OF SPRUCE BUDWORM PORTAGE, ME, -1972

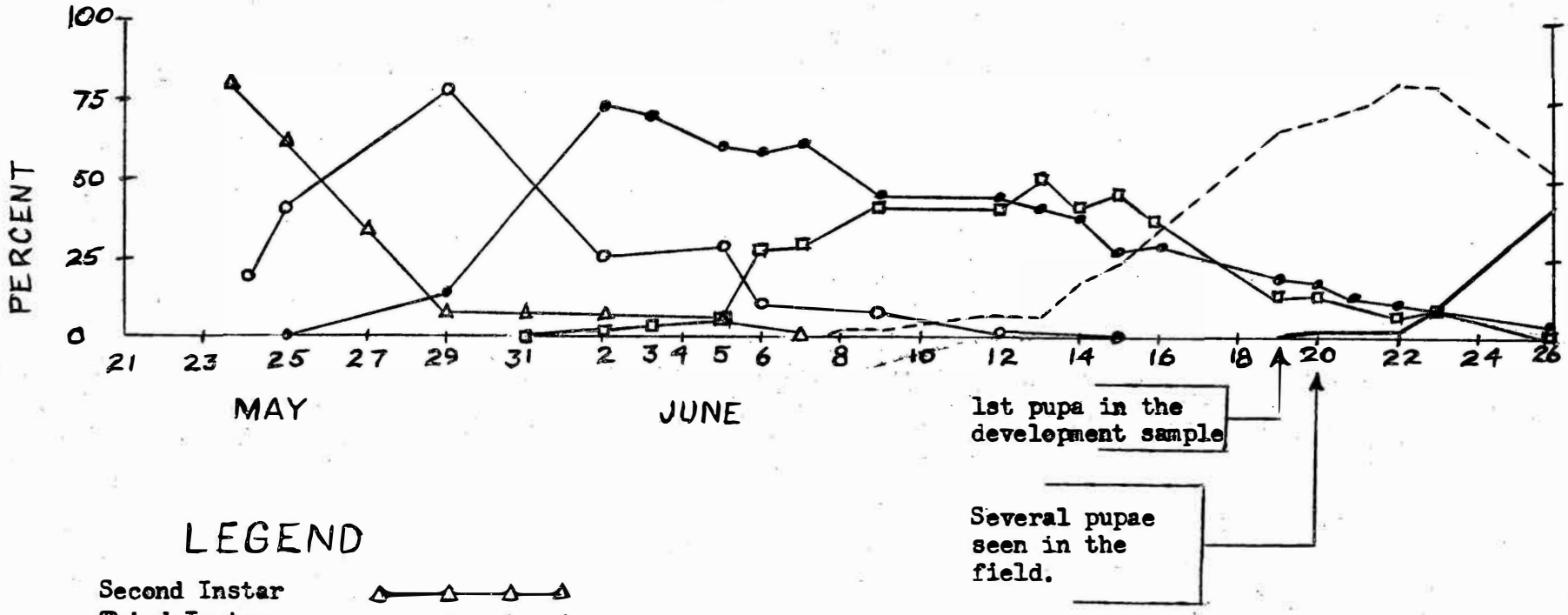
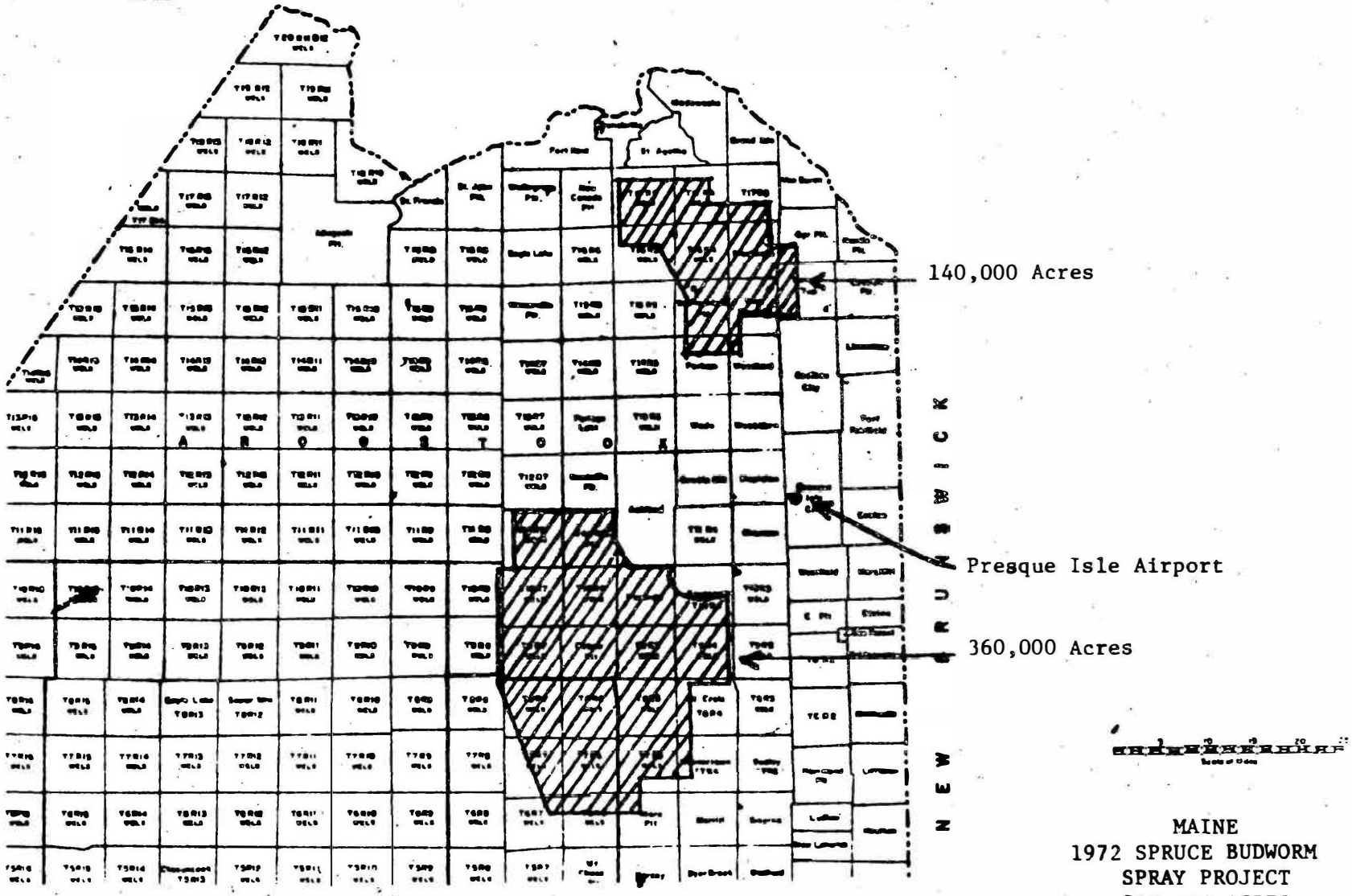


FIGURE 3



MAINE
1972 SPRUCE BUDWORM
SPRAY PROJECT
500,000 ACRES

Clearance for the project was obtained from the Maine Board of Pesticide Control. The State Legislature approved State funds in mid-March, but U.S. Forest Service funds were not made available until early April, when the Environmental Impact Statement was approved by the Federal Environmental Protection Agency (EPA). Funding was about 40% Federal, 30% State and 30% Maine Forestry District (private). The 40% Federal cost was in the form of all the Zectran FS-15 (Dow Chemical Company) insecticide stock solution used on the project. Actual costs for the project were $2.71 per acre, of which $2.62 were direct costs. The increased cost over previous project costs were reflected by higher insecticide and contract spray plane costs, as well as purchase of mixing and loading equipment. Due to large operations in New Brunswick, Forest Protection Ltd. of Canada was unable to rent us this equipment as they had in past operations.

Presque Isle airport (elevation 534 feet) was used as the base of operations for all application phases of the project and all airport personnel were housed and fed at the Maine Vocational Technical Institute, adjacent to the airport facility.

Zectran and malathion were both registered by EPA for use against the spruce budworm; however, Zectran was the material selected due to its less adverse impact on non-target organisms and greater consistency for satisfactory control of the budworm. Fenitrothion was not available because the American manufacturer, American Cyanamid Company, failed to seek registration following our 210,000 acre pilot-operational test of fenitrothion in 1970.

Zectran FS-15 stock solution was the material used. Dow Chemical Company shipped 50,000 gallons in late May to a railhead at the airport. It was diluted at Presque Isle by our personnel, 1 part Zectran stock solution to 9 parts kerosene, the kerosene supplied by Dead River Company. Each gallon of stock solution contained 1.5 lbs. actual ingredient (A.I.); each gallon of the mixture contained 0.15 lb. (2.4 oz.) A.I. Each gallon of stock solution therefore would treat 10 acres. Storage tanks with a total capacity of 108,000 gallons assured a constant supply of spray mixture. The excellent cooperation of the Fire Control Division in the plumbing, mixing and pumping phases of the airport operation is hereby acknowledged.

The mixture was applied at the rate of one gallon per acre by eleven PV-2 two-engine aircraft (capacity 1,200 gallons) and three TBM aircraft (capacity 800 gallons). The TBM's flew as a single team; the PV-2's flew in pairs or in three's. TBM spray swath width was 367 feet; swath width for each PV-2 was 550 feet. Fixed wing aircraft flew at 165 mph and at a height of 100-175 feet above the trees (500-1900 feet above sea level). Spray block size was usually nine miles in a north-south alignment by two and one-half miles across. Adjustments were made in block size for water areas and flight generally was from north to south and return. Two helicopters were used to treat 3,150 acres of lake shores and habited roadsides.

Spray nozzles No. 8015 (Spraying Systems Co.) were used on all fixed-wing aircraft and produced a 100+ m.m.d. droplet size. Helicopter spray nozzles were D5-23.

The seven Cessna guide planes used for spray plane alignment were supplied by Maine Aviation Corporation of Portland, Maine. Experienced navigators manned each guide plane and were supplied by Forest Protection Ltd. of Canada.

Spray operations started on June 8 when 90% of the larvae were in the fourth and fifth instars (a strong 20% were fifth), as determined by field crews at the Portage and Cross Lake field laboratories. Spraying was completed on June 25.

Average June temperature for the spray area was 58.4 degrees F. Weather records from the Caribou Weather Bureau for the month of June indicated temperatures were 2.5° higher than a 30 year average (1940-1970) and rainfall 0.90 inches higher. There were 17 days in which precipitation occurred; 12 of which produced measurable precipitation.

Adverse weather in the form of clouds, wind, fog, and generally unsettled weather from Hurricane Agnes caused serious delays. It was responsible for short spray periods (average = 1.9 hours) over a period of 18 days which resulted in spraying into the pre-pupal stage. By this time larvae had completed their phase of heaviest feeding damage and many were inactive, preparing for pupation.

Post-Spray Larval-Pupal Survey

Post-spray samples were collected from the same sample points and trees from which pre-spray samples were made. A total of 366 pre-and post-spray and pupal collections were made.

Spray Efficacy

Population data from the pre-and post-spray surveys were applied to Abbott's Formula. Table 1 indicates the percent reduction in larval survival by spraying amounted to approximately 85%. Foliage protection was fair in the Oxbow area and minimal in the Cross-Madawaska Lakes area. The two additional areas added to the original spray project late in the project and located west of Square Lake and east of Hanford Siding likewise resulted in poor control.

Safety Precautions

Ernest Richardson and Robert Batteese of the Maine Public Health Laboratory in Augusta monitored mixing, loading and spraying personnel for signs of cholinesterase depression. Only one pesticide poisoning incident occurred during this operation and resulted when a leak in a PV-2 spray boom-line sprayed Zectran on the co-pilot's clothing and soaked through to the skin. He was taken to the Presque Isle Hospital with severe headaches, but after proper attention was back flying in short order. The prompt recognition of trouble, attention to it, and rapid return of the pilot to good health attests to the professional and effective job done by these men from the Public Health Laboratory. Fire and police protection and radio communications systems were as in preceeding operations. The excellent cooperation received by the City of Presque Isle Public Safety personnel and our Radio division is also hereby acknowledged.

TABLE 1 **Summary of 1972 Zectran Treatment against Spruce Budworm** (Data subject to further evaluation and correction)

	Treated Area (81 locations)	Untreated Area (38 locations)
Total number of budworm larvae before treatment	54,334	15,884
Total number of surviving budworm after treatment	3347	6534
Survival	.062	.411

$$\text{Percent reduction in survival by spraying} = \frac{\text{Unsprayed population} - \text{sprayed population}}{\text{Unsprayed population}} \times 100$$

$$= \frac{.411 - .062}{.411} \times 100 = 84.9$$

Monitoring Studies

The late Francis M. Rushmore, U.S.F.S. Silviculturist, conducted sapsucker nesting studies for the ninth consecutive year and checked 17 nests prior to, during, and following the operational Zectran application in June. Due to a delay in spraying caused by high winds and rain, he found that 8 sapsucker nests clearly showed abandonment or abnormalities prior to any application of spray. Had spraying occurred at the time of these nest checks, the chemical may have been suspect.

Birds observed prior to spray application and survived the spraying as of June 30 were as follows:

Sapsuckers - 115
Evening Grosbeask - Hundreds
Birds other than sapsuckers and Evening Grosbeaks - 30

Red squirrels were observed casually in addition to noted bird observations, and apparently survived the spray application with no harmful effects according to Mr. Rushmore[1].

Cholinesterase determination was made on song birds by Frank Gramlich, U.S. Fish and Wildlife Service. No indicative trend or mortality on gross samplings occurred from Zectran at the rate of .15 lbs/A. Unless cholinesterese is depressed over 30% of normal, there is no danger. Apparently there is quite a variation in reaction to Zectran by different bird species. Fly catchers, vireos and grosbeaks showed a 10-12% depression level with no harmful effects. Warblers showed a 15% depression below normal levels. Sub-lethal reaction may make birds dopey and more susceptible to predation, but they usually recover in 2-3 hours.

Research

A cooperatively-funded field project involving the Forestry Department, U.S. Forest Service, and the University of Maine, tested the bacterium *Bacillus thuringiensis* (*B.t.*) as a biological control agent against the spruce budworm. The test was conducted by Dr. John Dimond, University of Maine, Orono, and consisted of application of B.t. plus chitanase. Foliage protection and population reduction figures were encouraging and justify large-scale tests in 1973. A detailed report of this test is available from Dr. Dimond.

Plans were also formulated to obtain a number of the pupal parasite *Brachymeria intermedia* for release in heavily populated budworm areas in 1973 in hopes that this parasite will become established, increase in numbers, and increase the rate of budworm parasitism.

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1. Correspondence F. Rushmore of July 10, 1972, Zectran Spraying Project, Spruce Budworm Control, 1972.

   See also Rushmore, Francis M. 1973. Techniques for Calling Sapsuckers and Finding their Nesting Territories. USDA For. Ser. Research Paper NE-281. 7 pp.

FOREST INSECT SURVEY AND PARASITE COLLECTIONS

Forest Insect Survey Collections

Forest Insect Survey collections by Fire Control and other departmental personnel by the beating method revealed widespread distribution north of Bangor and Rumford, with a few south of these points (Fig. 4).

Early and Late Larval - Pupal Parasitism

Analysis of dissection of 700 early larvae collected in T14R5, Wade, Westmanland, Connor, T17R5, Caswell and Perham revealed an overall mean % parasitism by *Apanteles*, *Glypta* and other parasites of 15.43%, with a standard deviation of 3.64.

Mean % parasitism by *Apanteles* was 9.29% and 6.00% for *Glypta* with respective standard deviations of 4.15 and 3.27.

A check for parasitism in late larval-pupal collections yielding a total of 4802 larvae and pupae revealed 47% were successful in reaching maturity as moths. The total number of Dipterous parasites was 71 for a percentage of 1%. Percent of hymenopterous parasitism was not possible to determine due to multiple parasitism (e.g. Chalcids).

SPRUCE BUDWORM AT LIGHT TRAPS IN 1972

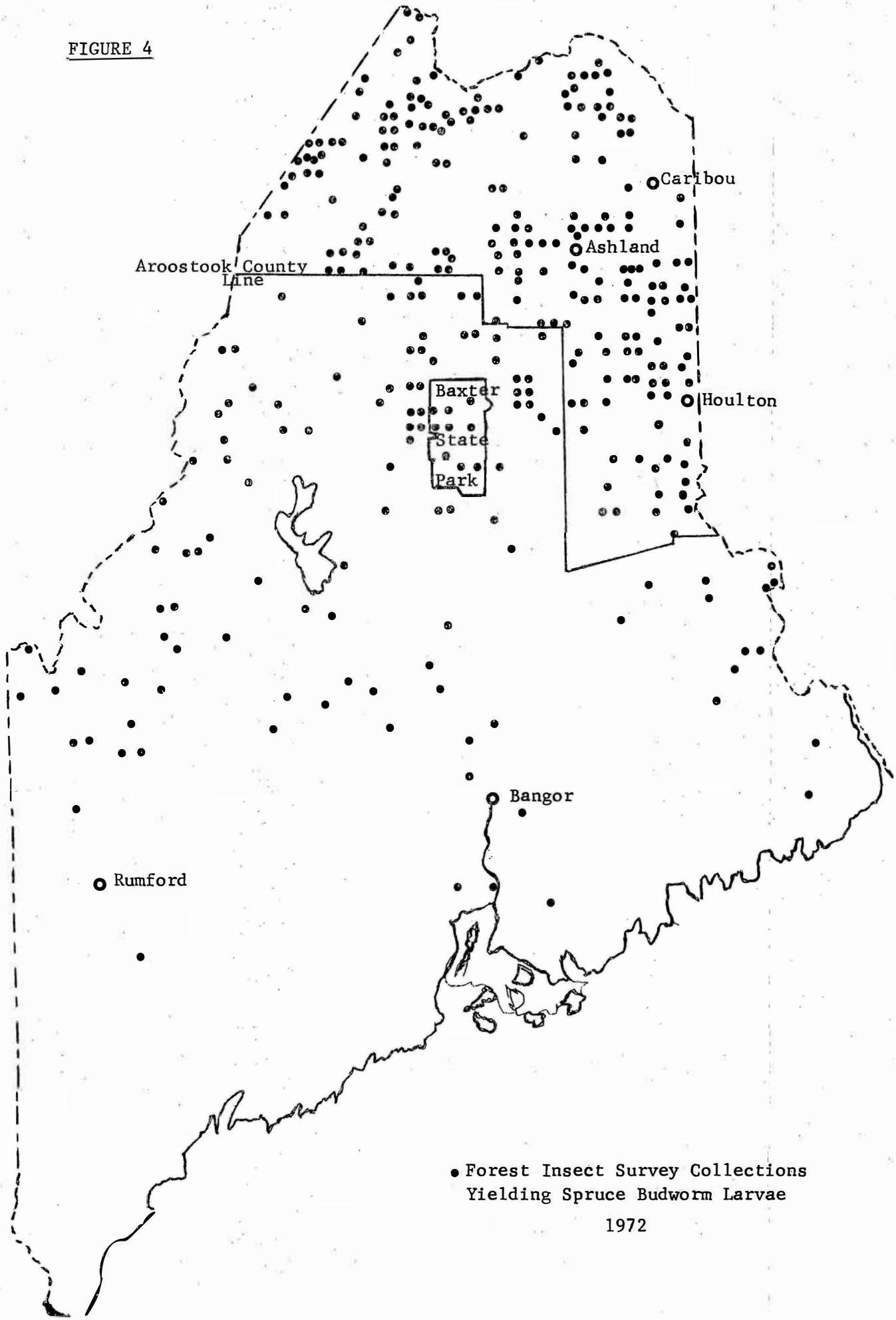
Light traps were operated during the month of July in 24 locations generally in the upper 2/3 of the State. Four customs locations were also monitored (Fig. 5). Heaviest catches were made on the evening of July 13 and 14. Nightly catches are listed in Table 2.

AERIAL DEFOLIATION SURVEY

An informal, aerial defoliation survey was conducted in early July by entomology personnel over the entire area infested by the spruce budworm and covered a far larger area than that actually sprayed. Ground observations were also made of intensity of current and past defoliation. For example, defoliation from Shin Pond west, Seboeis stream was medium to heavy; Trout Brook Farm had a trace; Black Brook was trace to light; the north branch of Trout Brook was medium to heavy. Traveling north on the Telos road, defoliation was medium to heavy, and spotty light to heavy from Telos Lake north. On the west Perimeter Road 10 miles south of Sourdnahunk Camp Ground, feeding was medium. Light to medium feeding occurred around Millinocket Lake. Atwood reported budworm everywhere in the Western Region. Four to six townships in the Telos-Umbasooksus-Chamberlain area were observed to have trees in rough shape.

For the first time an intensive aerial survey was conducted in the Washington Co. area (Fig. 6) and revealed heavy feeding west of the St. Croix River. Light to heavy 1972 defoliation seems to be intensifying in scope (Fig. 7), and a new epicenter has started in the Baker Lake area, T7R17 and T7R18.

FIGURE 4


Caribou
Ashland
Aroostook County Line
Baxter State Park
Houlton
Bangor
Rumford
• Forest Insect Survey Collections Yielding Spruce Budworm Larvae
1972

SPRUCE BUDWORM MOTHS FROM LIGHT TRAPS - 1972

FIGURE 5

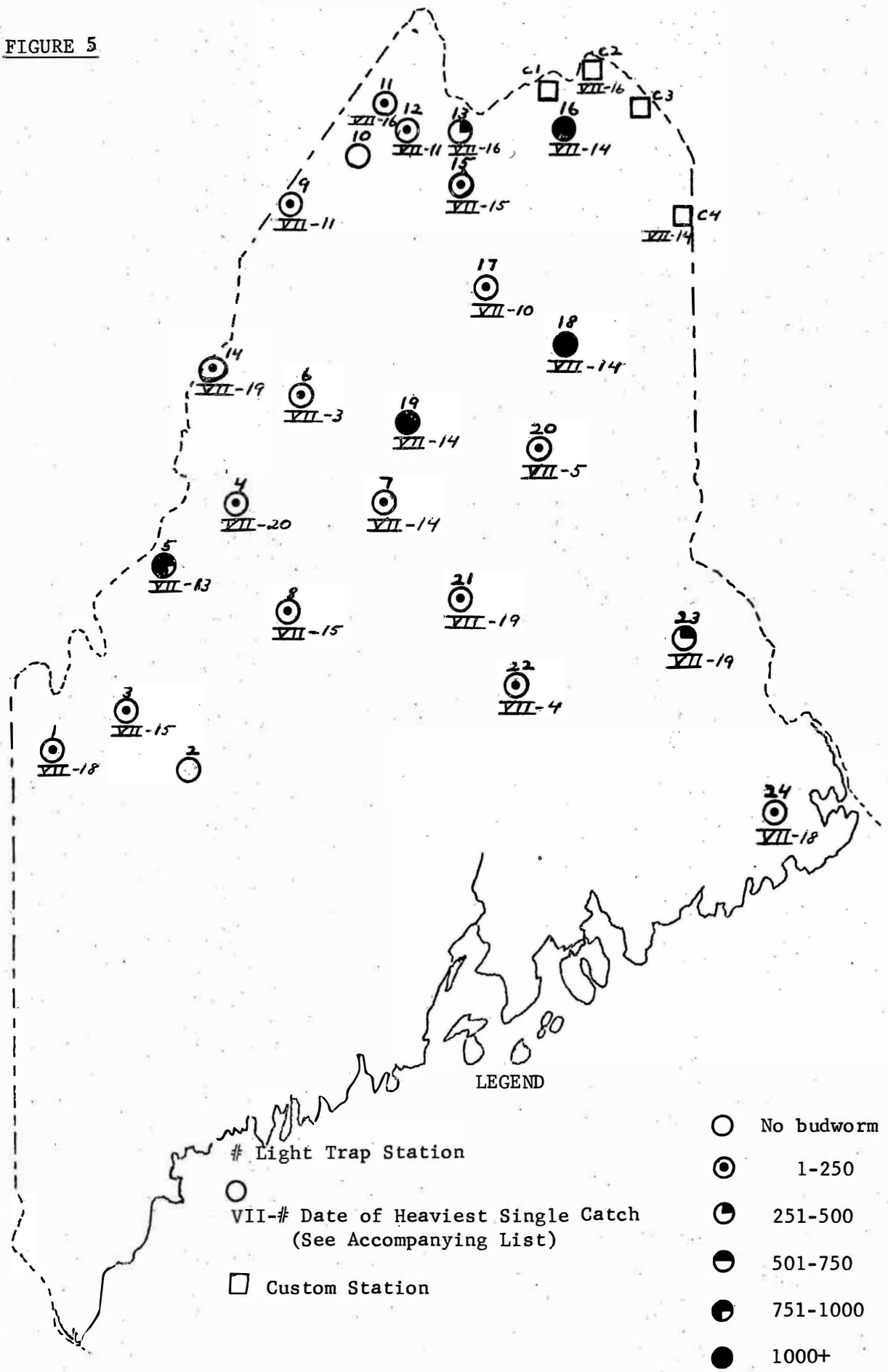


TABLE 2

SPRUCE BUDWORM MOTHS IDENTIFIED FROM LIGHT TRAP COLLECTIONS DURING 1972

DATES OF COLLECTIONS

TRAP		JULY 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	AUGUST 31	1	2	3	4	TOTAL
1.	Lower Cupsuptic		1						1					1			1		3		2	1	2													12
2.	Kingfield			1						2		2		1	2			1					2		1											12
3.	Eustis											1	6	17	22	25	17	10	5	2	1		4													110
4.	Pittston Farm(T2R4)									2		7	8	2	13	12	20		7		21	3									1					96
5.	Dennistown Plt.							1	2	3	13	20	12	147	83	100	122	60	34		93	54	57	2	5	3		3		2			3			819
6.	Caucomgomac(T7R15)		4	6															1	5																16
7.	Chesuncook Dam(T3R12)							2	2		1	3	1	8	21		2	9	2																	51
8.	Squaw Brook(T2R16)							2			3	3	1	22	12	26	12	5	1	5																92
9.	Depot Mt.(T14R16)											1																								1
10.	Chimenticook Stream(T16R13)																																			0
11.	Rocky Mtn.(T18R12)											3		7	7	1	11																			29
12.	Allagash(T17R11)											3	2						2	2																9
13.	St. Francis							1						2	1	12	110	28	45	12	29	34	27	19	9	30	2	5	7	2						375
14.	St. Cyprien											1	2	11	3	14		1	1	24		6		1												64
15.	DeBoulie Mtn.(T15R9)												1	22	34	55	4	16	6		15	43	2	1	2			1								202
16.	Cross Lake (T17R5)					2	7		4	18	26	352	89	228	888	322	245	34	31	233	24	28	23	3	1	11	26	4	9	8	1		7	1			2625
17.	Round Mtn.(T1IR8)										133			4	34	1	1	1	1	4		3				3	1		1		1					188
18.	Camp Dana(T9R5)	5		56				7		85	12	94	20	24	160	4500+	21	14	16	2	2		1				3	2								5024
19.	Round Pond Telos(T6R11)						3			26	13	138	15	70	5000+	147		114	23		21	10		22	3	3			1			3				5612
20.	Shin Pond (Mt. Chase Plt.)				20	7	12	11	5	10	10	10	9	8	10	11	9	7	12	1				1												143
21.	Long A. Twp.(TAR8&R9)			1		1				1				1		1	2	2	5	8											1					23
22.	Enfield		4	7		6			2	3				4	1	2		4	3	2		1	1	2		3						1				46
23.	Topsfield								1	3	1	1	3	3	1		1	12	107	132					1			1	1							268
24.	Marion					1	1			1	3	3	11		11	8	2		13	10	2		2	2	4	1			1	3	2	2	2	1	8	94
	Ft. Kent Customs																																			0
	Madawaska Customs																4																			4
	Van Buren Customs																																			0
	Fort Fairfield Customs														44																					44
	TOTAL	5	9	63	8	20	20	33	108	75	298	568	184	718	10687+	758	577	320	304	442	208	184	120	53	26	54	32	16	18	15	5	5	13	5	8	15,959

FIGURE 6

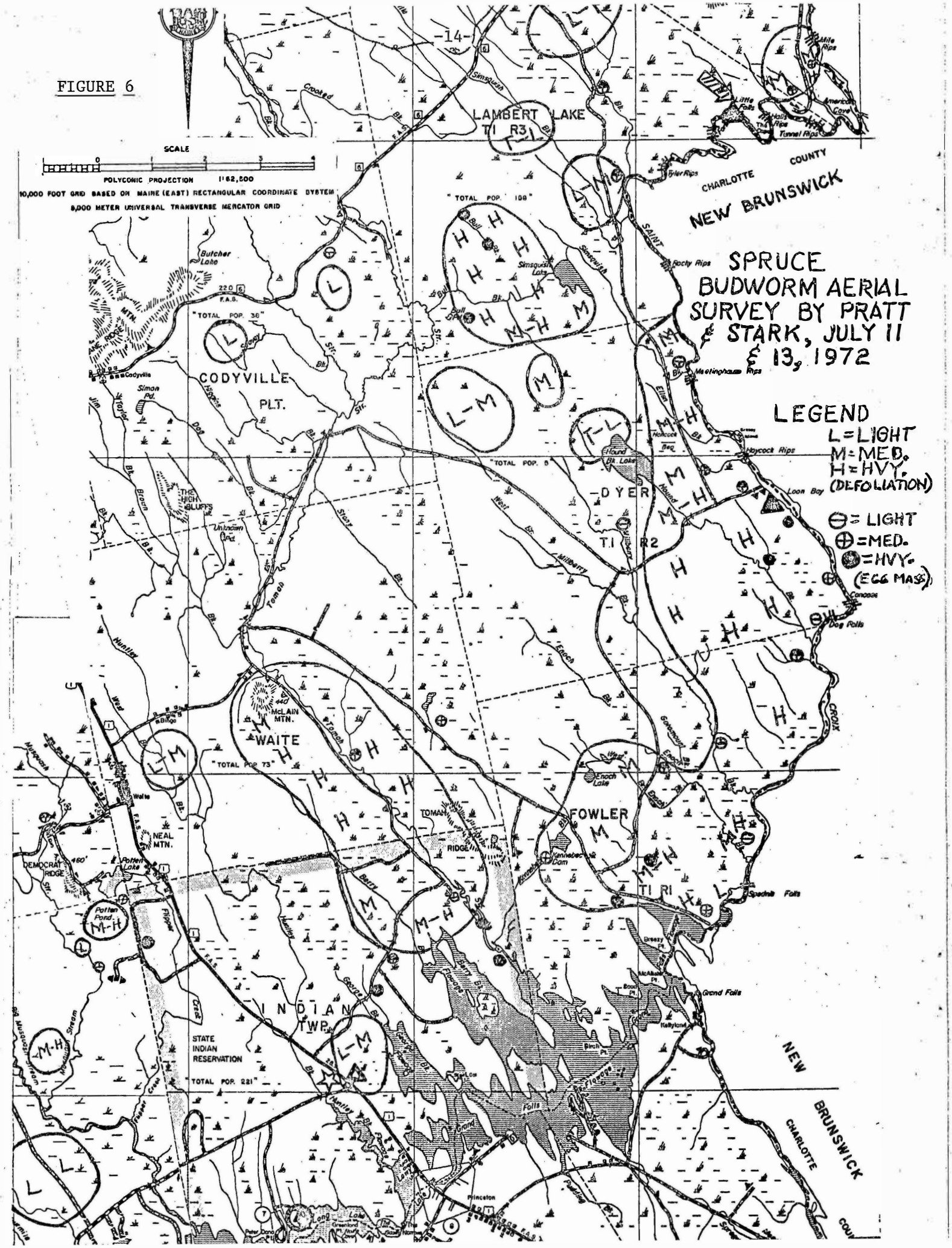
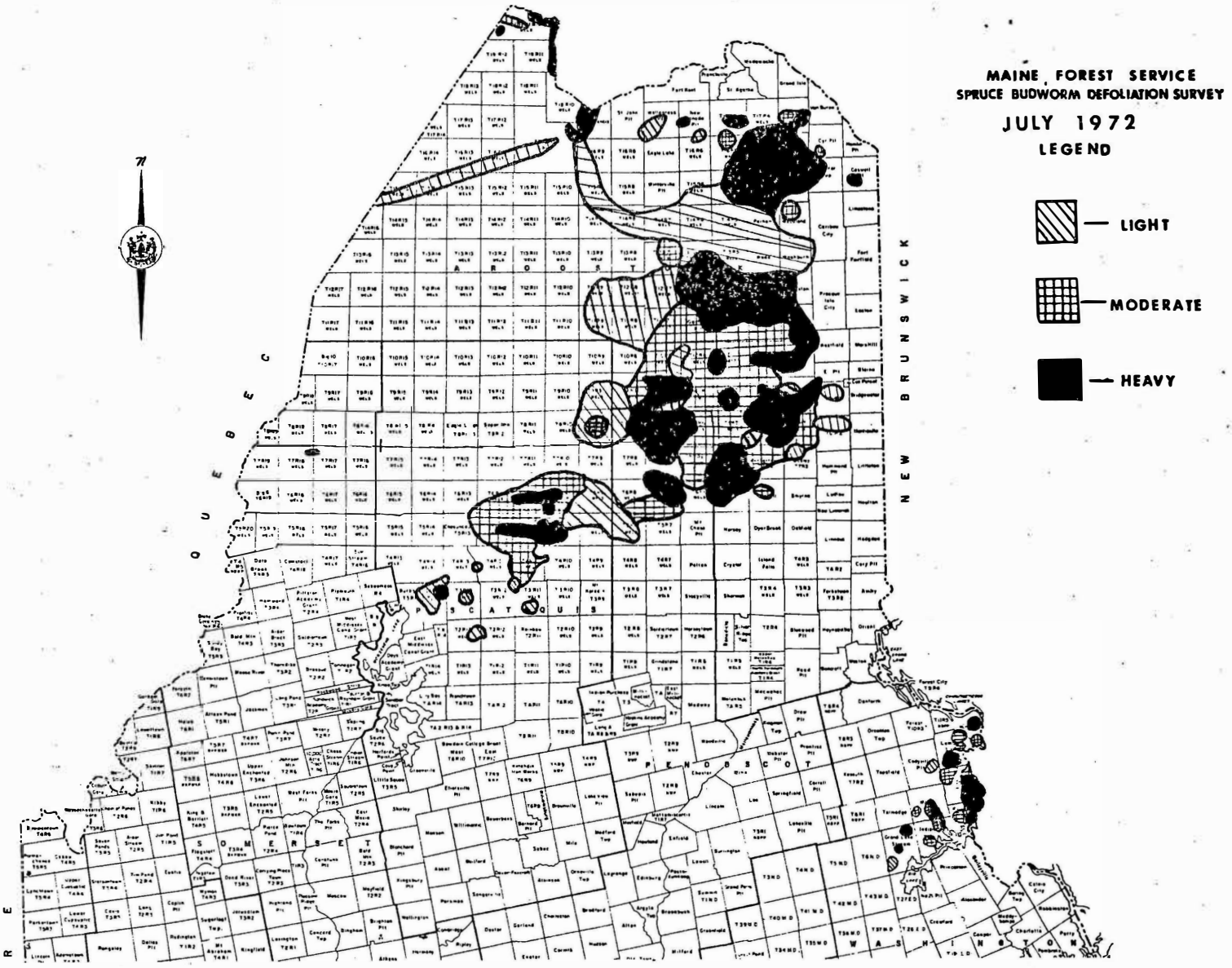

SCALE
POLYCONIC PROJECTION 1:62,500
10,000 FOOT GRID BASED ON MAINE (EAST) RECTANGULAR COORDINATE SYSTEM
8,000 METER UNIVERSAL TRANSVERSE MERCATOR GRID
SPRUCE BUDWORM AERIAL SURVEY BY PRATT & STARK, JULY 11 & 13, 1972
LEGEND
L = LIGHT
M = MED.
H = HVY.
(DEFOLIATION)
⊖ = LIGHT
⊕ = MED.
● = HVY.
(EGG MASS)
LAMBERT LAKE
T1 R3
CODYVILLE PLT.
DYER
T1 R2
WAITE
FOWLER
T1 R1
INDIAN TWP.
STATE INDIAN RESERVATION
"TOTAL POP. 108"
"TOTAL POP. 36"
"TOTAL POP. 5"
"TOTAL POP. 73"
"TOTAL POP. 221"
CHARLOTTE COUNTY
NEW BRUNSWICK
Butcher Lake
Simsquish Lake
Found Bk. Lake
Enoch Lake
Kennebec Dam
Grand Falls
Princeton
McLAIN MTN.
NEAL MTN.
THE HIGH BLUFFS
DEMOCRAT RIDGE
TOMAH RIDGE
Potten Pond
Long Lake
Greenland Lake
Pea Bone Lake
Little Falls
Tunnel Rips
Tyler Rips
Rocky Rips
Haycock Rips
Dog Falls
Spednic Falls
Loon Bay
Cancoss

FIGURE 7


MAINE FOREST SERVICE
SPRUCE BUDWORM DEFOLIATION SURVEY
JULY 1972
LEGEND
LIGHT
MODERATE
HEAVY
N
QUEBEC
NEW BRUNSWICK
AROOSTOOK
PISCATAQUIS
PENOBSCOT
SOMERSET
WASHINGTON

The survey revealed the spotty, inconsistent pattern of spray coverage, and possibly could only be explained by the variability in local thermal air currents, the presence of which at times prevented the spray solution from reaching target areas.

EGG MASS SURVEY - 1972

Surveying for budworm egg masses was begun the first week in August and was concentrated in areas with 1972 defoliation. Three Fire Control personnel were trained in the Western Region to supplement the two Insect Rangers. The Eastern and Northern Regions were also assisted by Fire Control personnel to enable coverage in hard-to-reach areas. Southern Region Entomology Division personnel assisted in the Northern Region. When Regional coverage was completed, regional collection teams were reassigned to the Northern Region to help complete the survey there. All collections were sent to the Portage and Cross Lake labs which employed a total of 14 lab checkers.

Analysis of 1972 egg mass and defoliation data indicated consideration of a possible spray project would be needed in 1973 on the following areas and acreages:

St. Francis	24,000 acres
Cross-Madawaska Lake	175,000 "
Oxbow	400,000 "
Telos	115,000 "
St. Croix (Boundary River)	50,000 "
Total	764,000 acres

There was some disagreement in egg mass counts since a decision was made not to separate new and old egg masses in 1972. During the week of Sept. 29, 1972, Buffam and McCowan of the U.S.Forest Service, in checking collected egg masses, found, in a total of 455 egg masses from 7 random collections, 45% new egg masses, 53% old egg masses, and 2% other. On 49 collections, they respectively found the following percentages:

47% new	50% new
52% old	49%old
1% other	1% other

Further checking indicated there are goodly numbers of old egg masses which remain adhered to needles into the following egg mass survey period; however, it was felt and later substantiated by the soaking-out of larvae in some areas, that USFS counts of old egg masses were too high and did not accurately portray expected larval populations for the following season. However, this analysis by U.S.F.S. personnel did point up the fact that the practice of separating old and new egg masses certainly needs to be continued, especially when egg mass deposit has been heavy to extreme the previous year.

AERIAL DAMAGE SURVEY

In late September, an intensive, aerial, budworm-damage survey was conducted from Millinocket Lake (T1R8 WELS), north to Scraggly Lake (T7R8 WELS), west to Caucomgomoc Lake (T7R15 WELS) and south to Tomhegan (T1R2 NBKP) on Moosehead Lake. The flight lines were 1 mile apart and flown with Forestry Department helicoptors with Regional Entomologists and Insect Rangers from the Northern, Eastern and Western Regions as observers. Department pilots were Robinson, Johnson and Dumond. Medium to heavy feeding damage was recorded generally in the Harrington Lake-Umbazooksus Lake-Second Lake, Grand Lake Matagamon areas with a small acreage of damaged trees in the Little Lobster Lake area between Shack and Salmon Ponds, T3R14 and T4R13 WELS.

SUMMARY

The over-all reduction in budworm populations due to spraying was figured at 85%. Data were gathered from 366 pre-and post-spray field collections taken over the area. The egg-mass survey conducted through August indicates sufficient 1973 populations to cause continuing heavy feeding and damage. The egg numbers are considerably less in the spray area than last year but many are still high enough to be classed well into the heavy, 1973 feeding category. Whether these egg categories were due to influx of moths or from resident moth populations remaining in the spray area is conjectural, but seems more likely due to the latter.

Foliage and tree protection resulting from the spraying were less than in previous years and less than desired in view of predicted 1973 larval populations. It is estimated that 5-10% of the merchantable fir in the spray area is either dead or beyond recovery. The remaining trees are not expected to improve sufficiently next spring to be out of danger in the face of the predicted 1973 populations and larval feeding pressures.

Larval feeding in 1972 was particularly severe because of extremely high populations. Zectran could not be applied early enough to prevent heavy new foliage loss (i.e. buds and new shoots). Weather conditions were adverse for spraying, with many delays and sub-average spray-periods due to non-flying weather or unstable air conditions.

At a joint meeting with representative of the U.S. Forest Service, land managers and owners, and representative of Forest Protection Ltd. of Canada on October 17 and 18, 1972, it was recommended that some 450,000 acres be sprayed in 1973 with the insecticide Zectran. Final acreage for the five areas under consideration were determined to be as follows:

Area	Acres
St. Francis	42,000
Long Lake	34,000
Square Lake	14,000
Squapan Lake	205,000
Telos Lake	155,000
Total	450,000

The St. Croix area in Washington County contained medium budworm populations as early as 1969, and larval populations there in 1972 were as high as 30 per 15-inch twig; however, this area was dropped from consideration due to heavy unsprayed populations directly across the river in Canada, a past history of above average parasitism, spray logistics and other considerations.

From our experience and judgement we see definite needs.

I. Earlier application of the insecticide in the larval feeding season to give more foliage and tree protection.

II. Two applications would also seem appropriate; one to start early in reducing intensity of feeding and saving of new foliage, a second or later application to further reduce populations and later feeding pressures of the larger larvae. The value of early foliage protection has been demonstrated in adjacent Canada as has the advantage with any insecticide being applied twice vs. once.

III. An insecticide with more budworm killing abilities is desired, as are less expensive insecticides such as fenitrothion and, to lower Zectran costs further, use of less carrier per acre.

IV. To those problems, strong and influential voices are needed to supplement our efforts with federal authorities in detailing the current insecticide situation and to obtain their action in implementing changes and in carrying out more research.

V. An intensified information and education program to educate the general public, associated environmental agencies, and financial managers of the need and value of protection against the budworm, and to increase the aid of involved land managers in control-area delineation decisions.

VI. Seeking of added and quicker survey methods to determine stand conditions as to need of protection along with volumes threatened. Increased acreages are becoming infested severely - our personnel numbers remain the same. A start has been made on this in August and September involving aerial photography.

VII. Earlier meetings with land managers to decide on protection action and involved funds. Geographical spread of problem areas may mean added and new operating bases and types of aircraft.

VIII. Consideration of the use of great ponds for the storage of pulp and the possibility of finding new markets for chips, should extensive salvage operations become necessary.

CONDITIONS IN ADJACENT CANADIAN MARITIME PROVINCES

In New Brunswick, the largest continuous areas of severe defoliation (loss of new needles and shoots of balsam fir and spruce) occurred in eastern Restigouche County, western Northumberland County, much of Victoria County, central Carleton County, near Millville, Parker Ridge and Oromocto Lake, York County, central Charlotte County, eastern Albert County, and near the Kent County line and east of Shepody Bay, Westmorland County. Numerous smaller patches of severe defoliation and extensive areas of moderate occurred throughout most of the Province south of a line from Belledune to St. Leonard through Mount Carleton and St. Quentin. A few very small pockets of moderate and severe defoliation occurred in the "panhandle" of Madawaska County.

In Nova Scotia, infestations continued in Cumberland County and in the Annapolis Valley. In Cumberland County, from the New Brunswick border south and east to the Springhill to Port Philip road, defoliation was light and moderate in patches with scattered pockets of severe. West of a line from Maccan through River Hebert, southwest along the game sanctuary west boundary to the Shulie River, and roughly south to Wards Brook, defoliation was mostly severe with areas of moderage occurring along the eastern boundary and from Wards Brook west. Patches of dead and dying trees were common. In the Annapolis Valley, severe defoliation of spruce and fir occurred on the Valley floor from Port William west to Bridgetown, over large areas on North Mountain from the Lookoff west to Hampton, and in patches north of a line from Forest Hill (Kings County) west through Morristown and New Albany to Lequille. Numerous patches of dead spruce and fir trees were observed along North Mountain from the Lookoff in Kings County west to Mount Hanley in Annapolis County.

In Prince Edward Island, moderate and severe current defoliation was more widespread than in 1971 in Prince County and occurred more often in scattered stands in Queens and Kings counties.

1. Summary Report of the Forest Insect and Disease Survey-Maritimes Region, July, 1972. Canada Department of the Environment, Maritimes Forest Research Centre, Fredericton, N.B.